(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) Publication number: **0 346 961 B1**

(12) EUROPEAN PATENT SPECIFICATION

(45) Date of publication of patent specification: **26.07.95** (51) Int. Cl.[6]: **E21B 33/138**, E21B 17/10

(21) Application number: **89201346.7**

(22) Date of filing: **25.05.89**

(54) Method and apparatus for placing a cement lining in a borehole.

(30) Priority: **14.06.88 GB 8814004**

(43) Date of publication of application:
20.12.89 Bulletin 89/51

(45) Publication of the grant of the patent:
26.07.95 Bulletin 95/30

(84) Designated Contracting States:
DE FR GB IT NL

(56) References cited:
GB-A- 2 134 947
US-A- 2 387 002
US-A- 3 526 280
US-A- 3 774 683
US-A- 3 976 139
US-A- 4 519 452

(73) Proprietor: **SHELL INTERNATIONALE RESEARCH MAATSCHAPPIJ B.V.**
Carel van Bylandtlaan 30
NL-2596 HR Den Haag (NL)

(72) Inventor: **Van Kleef, Rudolfus Petrus Antonius Robertus**
Volmerlaan 6
NL-2288 GD Rijswijk (NL)
Inventor: **Lohbeck, Wilhelmus Christianus Maria**
Volmerlaan 6
NL-2288 GD Rijswijk (NL)

EP 0 346 961 B1

Description

The invention relates to a method and apparatus for placing a cement lining alongside the wall of a borehole.

In the art of drilling wells in subsurface earth formations it is known to stabilize and reinforce the borehole wall by a cement lining.

A borehole stabilization technique of this type is known from U.S.S.R. Inventor's Certificate No. 723 102. This publication discloses a method of placing a cement lining alongside the wall of a borehole, the method comprising:

- lowering a tubular into the borehole until the lower end of the tubular has reached the bottom of a section of the borehole which is to be lined;
- introducing a cement slurry in an annular space surrounding the tubular and pumping a slug of drilling mud into the tubular until the mud has substantially reached the lower end of the tubular and the cement slurry substantially fills said annular space over the length of the borehole section which is to be lined;
- pulling the tubular in upward direction through the borehole; and
- allowing the cement to set.

In accordance with the known technique a shuttering in the form of temporary casing pipes is run into the well. Subsequently a cement slurry is pumped into the annular space around the pipes using a weighted mud. As soon as the mud has reached the lower end of the casing pipes the casing is pulled and guide plates mounted at the lower end of the casing spread the cement slurry mix over the borehole wall. The mud is left in situ where its specific gravity enables it to act as shuttering whilst the cement hardens.

A drawback of the known process is that in particular in non-vertical wells the weight of the casing and guide plates may cause an eccentric position of the plates within the borehole which results in an uneven thickness of the cement layer.

An object of the present invention is to remedy this drawback of the known process and to provide a method and an apparatus for placing a cement lining in a well such that even in a deviated well a cement lining of a constant thickness is formed.

To this end the method according to the invention is characterized in that the tubular comprises a stinger connected to the lower end of a tubing, in that the stinger is provided with a mixing sub consisting of a tubular element having an internal diameter which is larger than the outer diameter of the tubing, and arranging within the sub a mixing device, and mixing within the sub cement and mud to a soft cement core in response to pulling the tubing and stinger in upward direction through the borehole, and in that during pulling the tubing and the stinger in upward direction through the borehole the stinger is centralized in the borehole using centralizer means which are held in contact with the borehole wall and drag through the cement slurry alongside the borehole wall.

Experiments have shown that by proper sizing of the centralizer means the tracks formed in the cement slurry alongside the borehole wall by the sliding centralizer means fade away before hardening of the cement slurry so that no irregularities are left in the cement layer.

Preferably the centralizer means comprise a series of bow spring centralizer blades which are mounted near the lower end of the stinger. Utilization of bow spring centralizer blades will generally be sufficient in gauge, vertical, holes and in washouts. However, if cementing operations are carried out in highly deviated holes it is preferred to provide the centralizer means in addition with rigid ribs which are mounted at equally distributed angular intervals around the stinger. In that case the rigid centralizer ribs give centralization in the gauge and deviated hole sections whereas the bow spring centralizer blades stabilize the stinger in the washouts.

It is furthermore preferred to use bentonitic mud to create a stable channel in the cement plug, because as soon as it comes into contact with the cement the bentonite reacts with the cement. As a result a very viscous paste-like mud channel is left behind in the cement plug.

After the cement has set the mud channel may be reamed or dressed to a desired size. The mud channel then acts as a guide to the bit. The bit may be of a special type, e.g. equipped with a nose section that can easily follow the mud channel.

If desired instead of creating a mud channel in the cement plug a soft centred cement plug may be created as well. To accomplish setting of a soft centred cement plug the stinger may be equipped with a cement mixing sub in which mud is mixed with cement, thus creating in the cement plug a soft core which is easily drillable. It is observed that it is known from US patent specification No. 3 774 683 to drill a core in a solid cement plug in a borehole. However, in the absence of a mud channel or a soft centre in the cement plug placed in accordance with the known technique drilling of a centralized bore in the cement plug is difficult to accomplish. Thus it can be seen that a principal advantage of the borehole lining technique according to the invention over the prior art techniques is that always a cement lining of a constant thickness can be created.

The invention further relates to an an apparatus for placing a cement lining alongside the wall of a

borehole in accordance with the method of the invention. The apparatus comprises a stinger connected to an end of a tubing and means for centralizing the stinger in the borehole, said centralizer means comprising a series of centralizer elements which protrude in lateral direction away from the stinger such that in use the elements are held in contact with the borehole wall.

Such an apparatus is disclosed in British patent application publication No. 2 134 947. This publication, however, relates to conventionally fixing a tubing provided at its lower end with a liner in a borehole in a borehole by means of cement.

It is an object of the present invention to provide an apparatus that can provide a soft centred cement plug.

To this end the apparatus for placing a cement lining alongside the wall of a borehole according to the invention is characterized in that the stinger is equipped with a mixing sub, said sub comprising a tubular element which is mounted co-axially around the lower end of the stinger, and a conical mixing device mounted within the sub below and pointing towards said end of the stinger for mixing cement and mud to a soft cement core in response to pulling the tubing and stinger in upward direction through the borehole.

Reference is made to USA patent specification No. 3 976 139. This publication also relates to conventional cementing, wherein a tubing is fixed in a borehole by means of cement. The lower end of the tubing is provided with anchors arranged at its lower end which fix the position of the lower end of the tubing. During setting of the cement pull is exerted on the upper end of the tubing so that the tubing is held under tension when the cement sets.

Reference is further made to USA patent specification No. 3 526 280 also relating to conventional cementing, wherein a tubing is fixed in a borehole by means of cement.

The invention will now be explained in more detail with reference to the accompanying drawings in which

- Fig. 1A-1D show different stages of the well lining method according to the invention, and
- Fig. 2 shows a suitable embodiment of the well lining apparatus according to the invention,
- Fig. 3 shows an embodiment of the apparatus where the stinger is connected in a telescoping manner to the tubing, and
- Fig. 4 shows an embodiment of the apparatus where the stinger is connected to the tubing by a flexible hose.

Fig. 1A shows a borehole 1 of which an upper section has been lined with a cement coating 2 whereas a cement slurry 3 is being introduced by injection into a lower section of the borehole.

The cement slurry is injected via a tubing 5 and a stinger 6 into an annular space 7 surrounding the tubing 5 and stinger 6. The bottom-end of the stinger 6 is held in a centralized position in the borehole 1 by a bow spring centralizer 8, while the outlet 9 of the stinger is located just above the bottom 10 of the hole 1.

Before injecting the cement slurry the borehole has been cleaned, for example to remove any mud cake from the borehole wall, by circulating a scavenger slurry 12 at high velocity through the annular space 7. If the annulus has a large width expandable rubber wipers (not shown) may be secured to the outer surface of the stinger so as to provide a flow restriction in the annulus and to scrape off the mud cake when the stinger is run through the section to be treated.

The cement slurry 3 removes the scavenger slurry 12 from the annular space 7 and the cement slurry 3 is displaced from the interior of the stinger by a mud 13 of the same density as the cement slurry. The volume of the injected cement slurry 3 is selected such that the cement slurry fills the annular space 7 over the borehole section to be treated, whereas the volume of the heavy mud 13 injected behind the cement slurry is sufficient to establish the required mud core over the length of the borehole section to be treated. Subsequently the upper end of the annular space is closed by a collar known as a hydril or lubricator, so as to create a fixed cement column in the annular space 7, whereupon the tubing 5 and stinger 6 are pulled in upward direction as shown in Fig. 1B. To compensate for the net tubing volume being pulled out of the hole additional mud is allowed to flow into the tubing.

During the upward movement of the tubing 5 and stinger 6 the stinger spots a mud channel 15 in the plug of cement slurry 3. The diameter of the mud channel does not depend on the diameter of the outlet 9 of the stinger 6 but on the outer diameter of the tubing 5 which is pulled through the collar.

After the outlet 9 of the stinger 6 is above the zone to be treated as illustrated in Fig. 1C the annular space 7 is opened and excess cement and heavy mud are circulated from the borehole. Subsequently the cement is allowed to set.

As illustrated in Fig. 1D a drilling bit 17 is subsequently used to ream or dress the channel 15 to a bore of a desired diameter. The mud channel 15 acts as a guide to the drilling bit 17 to centralize the bit in the borehole. The bit 17 may be an underreamer bit or an eccentric bit and may be equipped with a nose (not shown) that can easily follow the mud channel 15.

The same bit 17 may be used to drill a next section of the borehole after the hole bottom 10

has been reached. Said next section may have a smaller diameter than the previously treated sections and may be provided with a cement lining which is placed using the same procedure as described above.

Alternatively said next section may have the same or larger diameter than the previously treated sections and it may be provided with a conventional steel casing or it may be left uncased, or be lined in the same manner as described before.

As shown in Fig. 2 the cement injection apparatus may be provided with a stinger 20 which is suspended from a coiled tubing 21 and equipped with a mixing sub 22.

The mixing sub 22 comprises a tubular element which is mounted co-axially around the lower end of the stinger 20 and a conical mixing device 24 which is mounted within said sub 22 below said end of the stinger 20 such that it points towards the stinger. In use mud and cement are mixed within the sub 22 in response to pulling of the tubing 21 and stinger 20 after injecting a cement slurry 25 into the annular space of a well interval which is to be treated.

The cement which enters the top 26 is mixed with mud which flows downwardly through the stinger 20 in response to pulling of the tubing so that below the sub 22 a mixture of mud and cement is created in the centre 27 of the borehole 28. After hardening of the cement the mud/cement mixture in the centre 27 of the borehole 28 forms a soft core which can be easily drilled out.

To ensure stabile centralization of the apparatus in the borehole 28 a series of rigid ribs 29 and a series of bow spring centralizer blades 30 are mounted at equally spaced angular intervals on the tubular outer surface of the mixing sub 22. The bow spring centralizer blades 30 serve to centralize the apparatus in gauge, vertical, hole sections whereas the rigid ribs 29 serve to centralize the apparatus in highly deviated hole sections. If desired the rigid ribs 29 may be replaced by bow spring stabilizer blades having a larger stiffness than the other stabilizer blades 30. Alternatively the stabilizer means may consist of a steel pin scraper or of a series of circumferentially spaced expandable arms which are held in contact with the borehole wall by spring action.

In the above manner proper centralization of the assembly is accomplished both in vertical and deviated boreholes or in holes with a varying diameter or irregular shape. Proper centralization of the assembly within the borehole ensures that the soft core is always placed in the centre of the borehole so that after drilling out the soft core a cement lining with a regular thickness is left alongside the borehole wall 28.

Fig. 3 shows an embodiment of the apparatus according to the invention where the stinger 33 is mounted in a telescoping manner inside a tubing 34. During lowering the assembly through the borehole the stinger 33 is in the illustrated contracted position. However, if after injecting the cement slurry into the annular space the tubing 34 is pulled, friction between the borehole wall and stabilizer blades 35 will cause the stinger 33 to be pulled out of the tubing 34 until the stinger 33 is in the extended position.

Fig. 4 shows an embodiment of the apparatus according to the invention where the stinger 41 is provided with two stabilizer assemblies 42 and 43, respectively. The stinger is connected to the tubing 44 by a flexible hose 45. The flexible hose 45 avoids that an eccentric position of the lower end 46 of the tubing in a deviated well section 47 would result in an eccentric position of the stinger 41.

The cement slurry may contain various additives to adapt its physical properties to well operations. Latex, polymers and epoxies may be added to the slurry to optimize the elastic properties of the cement and polypropylene or other fibres may be added to the slurry to improve the impact resistance of the cement and to plug off loss zones. Furthermore the wear resistance of the cement can be improved by adding wear resistant granules whereas the friction coefficient of the cement can be decreased by adding graphite, for example.

The cement may contain Portland cement but alternatively it may consist of an epoxy, polymeric or any other resin. The cement composition may furthermore vary over the length of the borehole.

It is furthermore preferred to use bentonitic mud to create the channel in the cement plug because, as soon as it comes into contact with the hydraulic cement, the bentonite reacts with the cement. As a result a very viscous, paste-like, mud channel is left in the cement plug. The mud may furthermore contain additives which thicken the mud when it comes into contact with hydraulic cement or which act as an accelerator for the setting of cement.

It is important that a good bonding is obtained between the cement and the borehole wall. Hence it is generally necessary to wash away any mud cake or debris from the borehole wall before injecting the cement.

If the stinger is suspended from a large diameter pipe string a narrow annular space is created in which a high fluid velocity can be created. As a result of said high fluid velocity the mud cake can be washed away before placing the cement. However a disadvantage of suspending the stinger from a pipe string is that pulling of the stinger has to be interrupted to break the pipe connections. These

interruptions may cause balloons in the mud channel because of pressure relaxation.

To avoid creating of balloons in the mud channel it is generally preferred to suspend the stinger from a small diameter coiled tubing which can be pulled at a constant speed throughout the interval to be treated.

In view of the large annular space around such a small diameter coiled tubing it may be necessary to attach steel reinforced rubber wipers to the outer surface of the stinger and/or tubing. These wipers act as a flow restriction in the annular space resulting locally in high annular fluid velocities. The wipers furthermore scrape off the filter cake from the borehole wall when the stinger is run through the borehole section to be treated. Mud may be circulated while running the stinger down.

It will further be understood that after injecting the cement slurry into the annular space around the tubing and stinger and before hardening of the cement the tubing may be moved up and down again through the borehole section to be treated before eventually filling the tubing and stinger with heavy mud and pulling them through the cement plug in order to create the mud channel or soft core therein.

Finally, it will be understood that instead of injecting the cement slurry via the stinger into the well, the slurry may also be introduced prior to lowering of the stinger into the well. In that case the slurry completely fills a lower section of the borehole when the stinger is lowered into the hole. Once the stinger has reached the bottom of the hole drilling mud is injected into the interior of the tubing and stinger until this interior is completely filled with mud, whereupon the tubing and stinger are retrieved from the borehole in the manner described with reference to Figure 1B.

Claims

1. A method of placing a cement lining (2) alongside the wall of a borehole (1), the method comprising:
   - lowering a tubular (5 and 6) into the borehole (1) until the lower end of the tubular (5 and 6) has reached the bottom of a section of the borehole (1) which is to be lined;
   - introducing a cement slurry (3) in an annular space (7) surrounding the tubular (5 and 6) and pumping a slug of drilling mud (13) into the tubular (5 and 6) until the mud (13) has substantially reached the lower end of the tubular (5 and 6) and the cement slurry (3) substantially fills the annular space (7) over the length of the borehole section which is to be lined;
   - pulling the tubular (5 and 6) in upward direction through the borehole (1); and
   - allowing the cement to set,

   characterized in that the tubular (5 and 6) comprises a stinger (6) connected to the lower end of a tubing (5), in that the stinger (6) is provided with a mixing sub (22) consisting of a tubular element having an internal diameter which is larger than the outer diameter of the tubing (5), and arranging within the sub (22) a mixing device (24), and mixing within the sub (22) cement and mud to a soft cement core in response to pulling the tubing (5) and stinger (6) in upward direction through the borehole (1), and in that during pulling the tubing (5) and the stinger (6) in upward direction through the borehole (1) the stinger (6) is centralized in the borehole (1) using centralizer means (8) which are held in contact with the borehole wall and drag through the cement slurry (3) alongside the borehole wall.

2. The method of claim 1 wherein the stinger (6) is centralized in the borehole (1) by centralizer means (8) comprising a series of bow spring centralizer blades (30) which are mounted near the lower end of the stinger (6).

3. The method of claim 2 wherein the centralizer means (8) are further equipped with rigid ribs (29) which are mounted at equally distributed angular intervals around the stinger (6).

4. The method of claim 1 wherein behind the cement slurry (3) a slug of bentonitic mud (13) is pumped into the tubing (5) and stinger (6), the mud (13) having a density which is substantially equal to the density of the cement slurry (3).

5. The method of claim 1 wherein after the step of pumping the mud (13) into the tubing (5) and stinger (6) the annular space (7) is closed either at the wellhead or at the top of the borehole section which is to be lined.

6. The method of claim 1 wherein prior to lowering the tubing (5) and stinger (6) into the borehole (1) a cement slurry (3) is introduced into the borehole (1) such that the cement slurry (3) completely fills a lower section of the borehole (1), whereupon after lowering the tubing (5) and stinger (6) to the borehole bottom drilling mud is injected into the interior of the tubing (5) and stinger (6) until the mud has reached the lower end of the stinger (6).

7. The method of any one of claims 1 to 6 wherein after hardening of the cement a drilling device (17) is lowered into the borehole (1) and actuated to drill an open space of a desired width in the centre of the cement plug.

8. An apparatus for placing a cement lining alongside the wall of a borehole (1), the apparatus comprising a stinger (6) connected to an end of a tubing (5) and means for centralizing the stinger (6) in the borehole (1), the centralizer means (8) comprising a series of centralizer elements which protrude in lateral direction away from the stinger (6) such that in use the elements are held in contact with the borehole wall, characterized in that the stinger (6) is equipped with a mixing sub (22), the sub (22) comprising a tubular element which is mounted co-axially around the lower end of the stinger (6), and a conical mixing device (24) mounted within the sub (22) below and pointing towards the end of the stinger (6) for mixing cement and mud to a soft cement core in response to pulling the tubing (5) and stinger (6) in upward direction through the borehole (1).

Patentansprüche

1. Verfahren zum Setzen einer Zementauskleidung (2) entlang der Wand eines Bohrlochs (1), bei dem man:
   - ein Rohrgestänge (5 und 6) in das Bohrloch (1) herabläßt, bis das untere Ende des Rohrgestänges (5 und 6) die Sohle eines Abschnitts des auszukleidenden Bohrlochs (1) erreicht hat,
   - einen Zementschlamm (3) in einen Ringraum (7) um das Rohrgestänge (5 und 6) herum einbringt und einen Stoß Bohrschlamm (13) in das Rohrgestänge (5 und 6) einpumpt, bis der Schlamm (13) im wesentlichen das untere Ende des Rohrgestänges (5 und 6) erreicht hat und der Zementschlamm (3) im wesentlichen den Ringraum (7) über die Lange des auszukleidenden Bohrlochabschnitts ausfüllt,
   - das Rohrgestänge (5 und 6) durch das Bohrloch (1) heraufzieht und
   - den Zement abbinden läßt,

   dadurch gekennzeichnet, daß das Rohrgestänge (5 und 6) eine mit dem unteren Ende eines Rohrs (5) verbundene Vorschubstange (6) umfaßt, daß die Vorschubstange (6) mit einem Mischübergangsstück (22) versehen ist, das aus einem rohrförmigen Element mit einem Innendurchmesser besteht, der größer ist als der Außendurchmesser des Rohrs (5), wobei innerhalb des Übergangsstücks (22) eine Mischvorrichtung (24) angeordnet ist und wobei innerhalb des Übergangsstücks (22) Zement und Schlamm unter der Einwirkung des Heraufziehens des Rohrs (5) und der Vorschubstange (6) durch das Bohrloch (1) zu einem weichen Zementkern vermischt werden, und daß während des Heraufziehens des Rohrs (5) und der Vorschubstange (6) durch das Bohrloch (1) die Vorschubstange (6) im Bohrloch (1) unter Anwendung von Zentriermitteln (8) zentriert wird, die mit der Bohrlochwand in Berührung gehalten werden und den Zementschlamm (3) entlang der Bohrlochwand durchschleppen.

2. Verfahren nach Anspruch 1, wobei die Vorschubstange (6) im Bohrloch (1) durch Zentriermittel (8) zentriert wird, die aus einer Reihe in der Nähe des unteren Endes der Vorschubstange (6) angebrachter Zentrierbogenfederblätter (30) bestehen.

3. Verfahren nach Anspruch 2, wobei die Zentriermittel (8) ferner mit starren Rippen (29) versehen sind, die in gleichen Winkelabständen verteilt um die Vorschubstange (6) herum angebracht sind.

4. Verfahren nach Anspruch 1, wobei hinter dem Zementschlamm (3) ein Stoß Bentonitschlamm (13) in das Rohr (5) und die Vorschubstange (6) gepumpt wird, wobei der Schlamm (13) eine Dichte besitzt, die weitgehend gleich derjenigen des Zementschlamms (3) ist.

5. Verfahren nach Anspruch 1, wobei nach dem Schritt des Pumpens des Schlamms (13) in das Rohr (5) und die Vorschubstange (6) der Ringraum (7) entweder am Bohrlochkopf oder an der Krone des auszukleidenden Bohrlochabschnitts geschlossen wird.

6. Verfahren nach Anspruch 1, wobei vor dem Herablassen des Rohrs (5) und der Vorschubstange (6) in das Bohrloch (1) ein Zementschlamm (3) so in das Bohrloch (1) eingeführt wird, daß der Zementschlamm (3) einen unteren Abschnitt des Bohrlochs (1) völlig ausfüllt, woraufhin nach dem Herablassen des Rohrs (5) und der Vorschubstange (6) auf die Sohle des Bohrlochs Bohrschlamm in das Innere des Rohrs (5) und der Vorschubstange (6) eingepreßt wird, bis der Schlamm das untere Ende der Vorschubstange (6) erreicht hat.

7. Verfahren nach einem der Ansprüche 1 bis 6, wobei man nach dem Erhärten des Zements eine Bohrvorrichtung (17) in das Bohrloch (1) herabläßt und zum Bohren eines offenen Raums gewünschter Breite im Zentrum des Zementpfropfens in Gang setzt.

8. Vorrichtung zum Setzen einer Zementauskleidung entlang der Wand eines Bohrlochs (1), wobei die Vorrichtung aus einer mit einem Ende eines Rohrs (5) verbundenen Vorschubstange (6) und Mitteln zum Zentrieren der Vorschubstange (6) im Bohrloch (1) besteht und wobei die Zentriermittel (8) aus einer Reihe von Zentrierelementen bestehen, die seitlich von der Vorschubstange (6) so abstehen, daß die Elemente im Gebrauch in Berührung mit der Bohrlochwand gehalten werden, dadurch gekennzeichnet, daß die Vorschubstange (6) mit einem Mischübergangsstück (22) versehen ist, wobei das Übergangsstück (22) aus einem rohrförmigen, koaxial um das untere Ende der Vorschubstange (6) herum angeordneten Element und einer innerhalb des Übergangsstücks (22) unter dem unteren Ende der Vorschubstange (6) und auf dieses weisend angeordneten konischen Mischvorrichtung (24) besteht, um Zement und Schlamm während des Heraufziehens des Rohrs (5) und der Vorschubstange (6) durch das Bohrloch (1) zu einem weichen Zementkern zu vermischen.

Revendications

1. Un procédé pour placer un revêtement de ciment (2) le long de la paroi d'un puits (1), selon lequel :
   - on fait descendre un appareillage tubulaire (5 et 6) dans le puits (1) jusqu'à ce que l'extrémité inférieure de l'appareillage tubulaire (5 et 6) ait atteint le fond d'une section du puits (1) qui est à revêtir ;
   - on introduit un lait de ciment (3) dans un espace annulaire (7) entourant l'appareillage tubulaire (5 et 6) et on refoule un bouchon de boue de forage (13) dans l'appareillage tubulaire (5 et 6) jusqu'à ce que la boue (13) ait atteint substantiellement l'extrémité inférieure de l'appareillage tubulaire (5 et 6) et que le lait de ciment (3) remplisse substantiellement l'espace annulaire (7) sur la longueur de la section du puits qui est à revêtir ;
   - on tire l'appareillage tubulaire (5 et 6) vers le haut dans le puits (1) ; et
   - on laisse le ciment faire prise,

   caractérisé en ce que l'appareillage tubulaire (5 et 6) comprend un dard (6) relié à l'extrémité inférieure d'une colonne (5), en ce que le dard (6) est pourvu d'un raccord mélangeur (22) constitué d'un élément tubulaire ayant un diamètre intérieur plus grand que le diamètre extérieur de la colonne (5), et un dispositif mélangeur (24) est disposé dans le raccord (22), et effectue dans le raccord (22) un mélange de ciment et de boue pour donner une âme de ciment mou quand on tire la colonne (5) et le dard (6) vers le haut dans le puits (1), et en ce que quand on tire la colonne (5) et le dard (6) vers le haut dans le puits (1), le dard (6) est maintenu en position centrale dans le puits (1) par des moyens de centrage (8) qui sont maintenus en contact avec la paroi du puits et sont tirés à travers le lait de ciment (3) le long de la paroi du puits.

2. Le procédé selon la revendication 1 dans lequel le dard (6) est maintenu en position centrale dans le puits (1) par des moyens de centrage (8) comprenant une série de lames de ressort arquées de centrage (30) qui sont montées près de l'extrémité inférieure du dard (6).

3. Le procédé selon la revendication 2 dans lequel les moyens de centrage (8) sont pourvus en outre de membrures rigides (29) qui sont montées à des intervalles angulaires également distribués autour du dard (6).

4. Le procédé selon la revendication 1 dans lequel derrière le lait de ciment (3), un bouchon de boue bentonitique (13) est refoulé dans la colonne (5) et le dard (6), la boue (13) ayant une densité substantiellement égale à la densité du lait de ciment (3).

5. Le procédé selon la revendication 1 dans lequel après l'étape de refoulement de la boue (13) dans la colonne (5) et le dard (6), l'espace annulaire (7) est fermé soit à la tête du puits soit au sommet de la partie du puits qui est à revêtir.

6. Le procédé selon la revendication 1 dans lequel avant de faire descendre la colonne (5) et le dard (6) dans le puits (1), on introduit un lait de ciment (3) dans le puits (1) de façon que le lait de ciment (3) remplisse complètement une partie inférieure du puits (1) et ensuite, après avoir fait descendre la colonne (5) et le dard (6) jusqu'au fond du puits, on injecte de la boue de forage à l'intérieur de la colonne (5) et du dard (6) jusqu'à ce que la boue atteigne l'extrémité inférieure du dard (6).

7. Le procédé selon l'une quelconque des revendications 1 à 6 dans lequel, après la prise du ciment, on fait descendre un dispositif de forage (17) dans le puits (1) et on l'actionne pour forer un espace ouvert d'une largeur désirée dans le centre du bouchon de ciment.

8. Un dispositif pour placer un revêtement de ciment le long de la paroi d'un puits (1), le dispositif comprenant un dard (6) relié à une extrémité d'une colonne (5) et des moyens pour centrer le dard (6) dans le puits (1), les moyens de centrage (8) comprenant une série d'éléments de centrage qui font saillie en direction latérale à partir du dard (6) de telle sorte qu'en service les éléments sont maintenus en contact avec la paroi du puits, caractérisé en ce que le dard (6) est équipé d'un raccord mélangeur (22), le raccord (22) comprenant un élément tubulaire qui est monté coaxialement autour de l'extrémité inférieure du dard (6), et un dispositif mélangeur conique (24) monté à l'intérieur du raccord (22) au-dessous de l'extrémité du dard (6) et ayant sa pointe vers cette extrémité pour mélanger du ciment et de la boue afin de former une âme de ciment mou quand on tire sur la colonne (5) et le dard (6) pour les faire monter dans le puits (1).

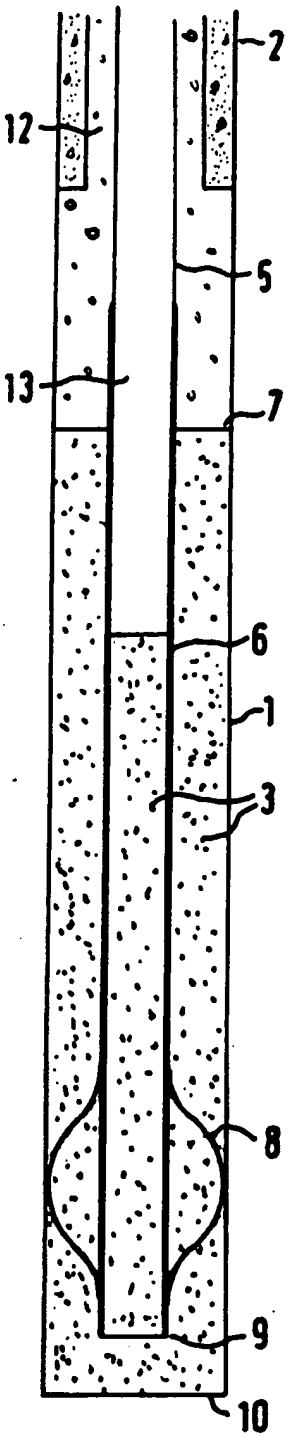

FIG.1A

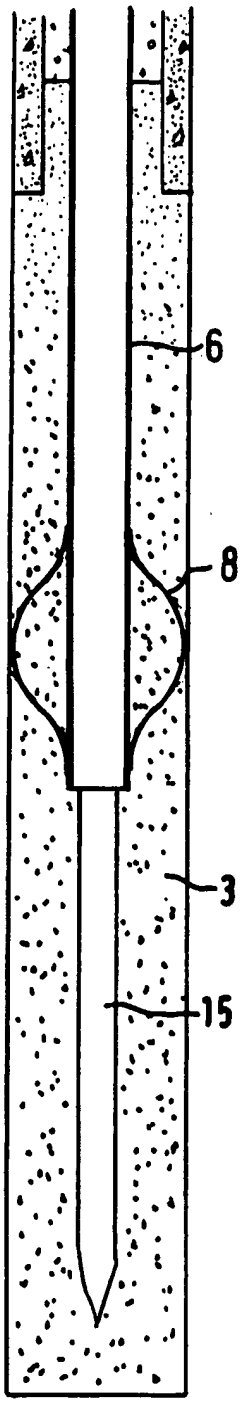

FIG.1B

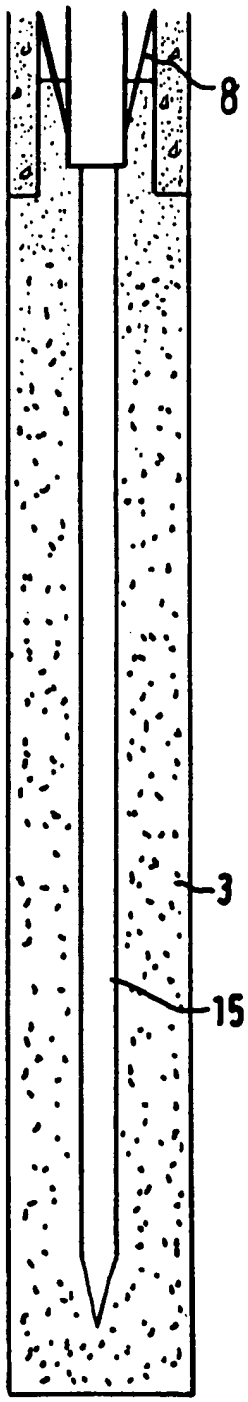

FIG.1C

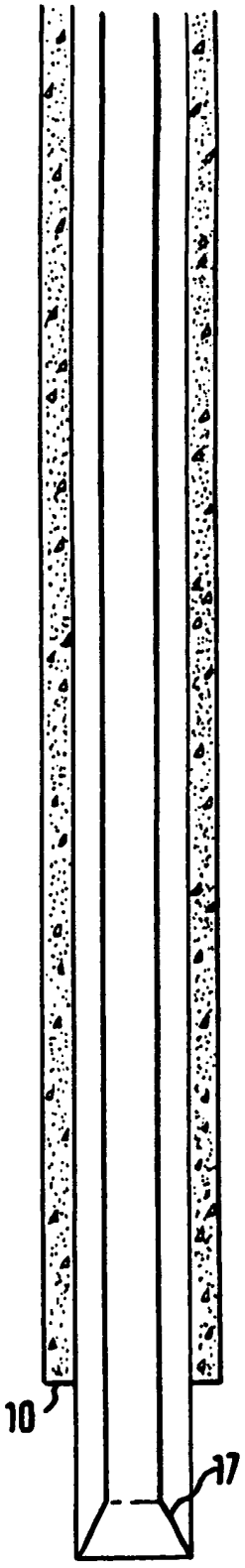

FIG.1D

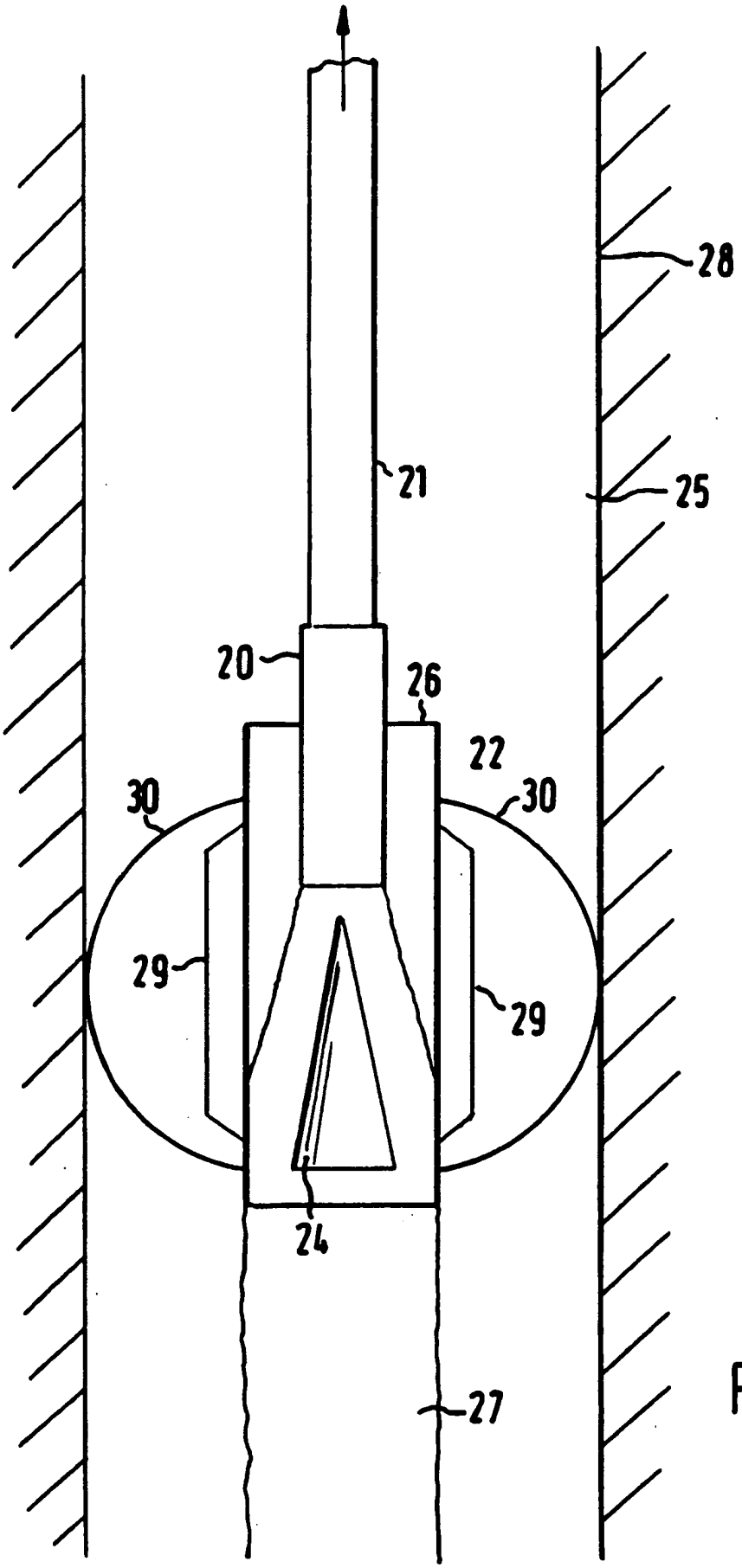

FIG.2

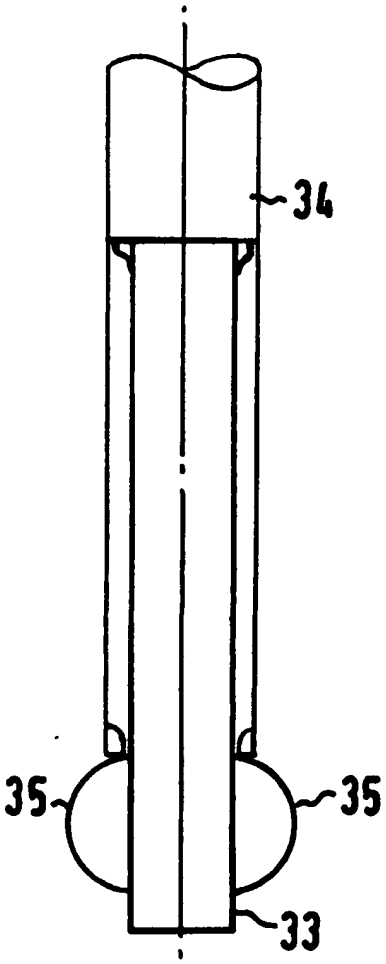

FIG.3

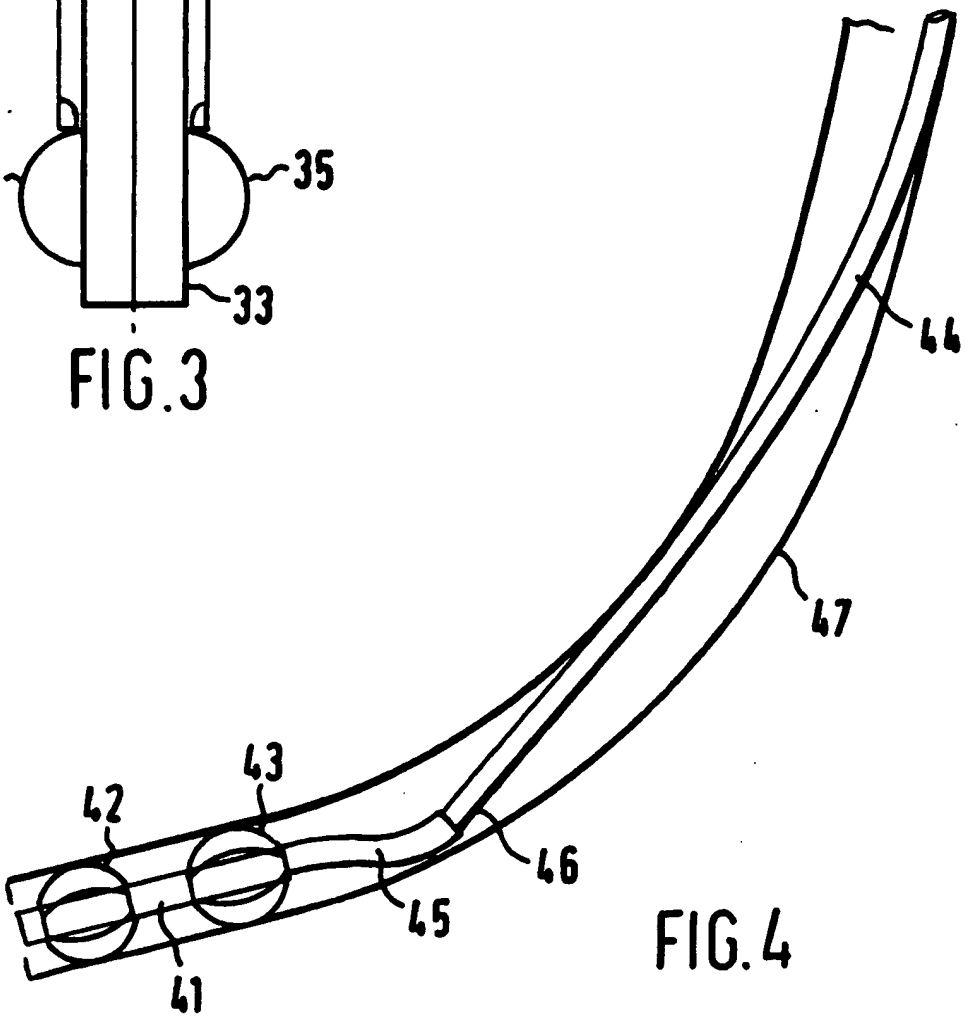

FIG.4